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## Natural Cycles in Iowa – Iowa Wildlife and People Series

Iowa Association of Naturalists

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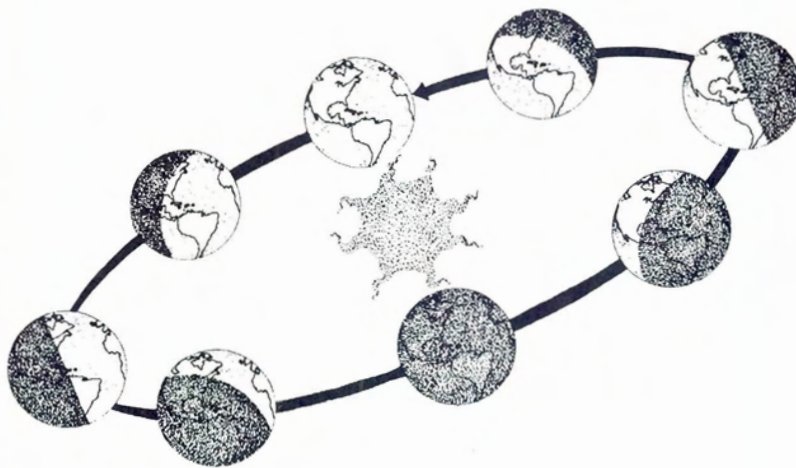
Iowa Association of Naturalists, "Natural Cycles in Iowa – Iowa Wildlife and People Series" (1995). *Iowa Naturalist Association Publications*. 14.

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# Natural Cycles in Iowa

*Iowa Association of Naturalists*



**Iowa Wildlife and People Series**





## *Iowa Association of Naturalists*

The Iowa Association of Naturalists (IAN) is a nonprofit organization of people interested in promoting the development of skills and education within the art of interpreting the natural and cultural environment. IAN was founded in 1978 and may be contacted by writing the Conservation Education Center, 2473 160th Rd., Guthrie Center, IA 50115, 515/747-8383.

### **Iowa Wildlife And People Series**

Students need to understand basic ecological concepts in order to understand the interconnecting roles of people, wildlife, and the environment. These interactions have a profound effect on attitudes and behaviors of people toward wildlife. The Iowa Association of Naturalists has created this series of booklets that offer a basic understandable overview of the interactions of wildlife and people and basic ecological concepts. These booklets will assist educators in teaching students about the basic concepts of ecology, exploring the ways wildlife and people interact, and clarifying some misconceptions about Iowa wildlife. The eight booklets in this series are:

*Iowa Wildlife Management* (IAN-401)  
*Keeping Iowa Wildlife Wild* (IAN-402)  
*Misconceptions About Iowa Wildlife* (IAN-403)  
*State Symbols of Iowa* (IAN-404)  
*Iowa Food Webs and other Interrelationships* (IAN-405)  
*Natural Cycles in Iowa* (IAN-406)  
*Iowa Biodiversity* (IAN-407)  
*Adapting To Iowa* (IAN-408)



The Iowa Wildlife And People booklet series is published by the Iowa Association of Naturalists with major funding from the REAP Conservation Education Board and with grants from the Iowa Conservation Education Council, the Iowa Wildlife Federation, and The Izaak Walton League of America (1995).



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Published by: Iowa Association of Naturalists



# Natural Cycles in Iowa

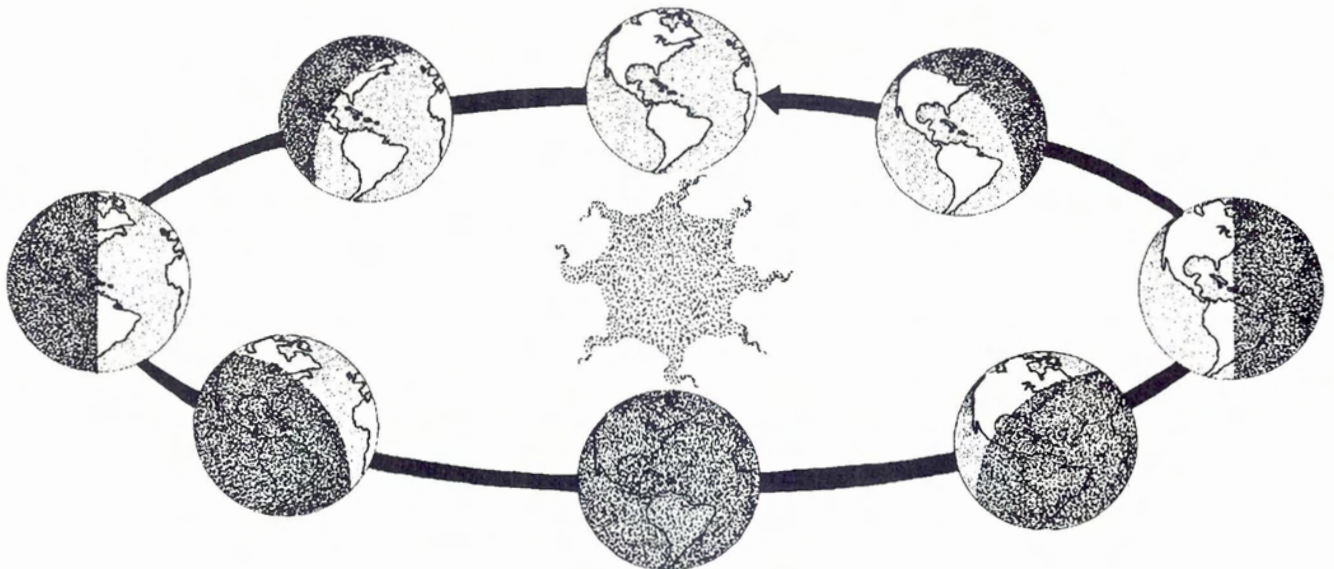
## Cycles are fundamental

*"But where does the sun go when the day ends?" the little boy asked.  
"The day doesn't end," said his mother. "It begins  
somewhere else. The sun will be shining there, when night begins here.  
Nothing ends... It begins in another place or in a different way."*

— from *When the Wind Stops* by Charlotte Zolotow

Charlotte Zolotow's book, *When the Wind Stops*, beautifully captures the cyclical patterns of nature. Cycles are so fundamental in nature that they provide an important window to ecological understanding. We constantly interact with cycles — using and abusing them. An awareness and understanding of natural cycles can allow us to work toward more sustainable lifestyles.

The Earth rotates  
through phases of day to night.





## Cycle curiosity

### So what is a cycle?

*Natural cycles are the processes by which all essential materials flow through the living and the non-living parts of ecosystems. Ecosystems receive materials as inputs and release them as outputs. The circular path of material flow - hence the term "cycle" - reuses the basic elements over and over. Natural cycles breathe life into ecosystems, supplying them with necessary nutrients, energy, and water. Examples include the water, carbon, and nitrogen cycles.*

**T**he smooth and steady functioning of cycles directly impacts ecosystem stability. Conversely, disturbed cycles contribute directly to ecosystem vulnerability. One example of the connections between cycles and the well-being of ecosystems is water pollution that results in fish kills. Heavy inputs of nitrates into the water cycle and subsequent chemical reactions can deplete oxygen levels and result in the death of fish and other living creatures in a stream or pond.

### Cycle types

The most familiar of all the cycles is the **water cycle**. The movement of water is critical in all cycles. Because it is so familiar and such an integral part of other cycles, the water cycle helps to demonstrate connections between local and global ecosystems.

Other cycles are categorized as either gaseous or sedimentary, depending upon the main source of nutrients. The bulk of **gaseous cycles** — including the oxygen, carbon, and nitrogen cycles — is stored in the atmosphere or the ocean. The main source of **sedimentary cycles** — such as the

phosphorous cycle — is the soil and the sedimentary and other rocks of the earth's crust. Often complex processes are involved in harvesting gaseous nutrients from the atmosphere and weathering or flushing sedimentary nutrients from the earth's crust.

Together, the many natural cycles contribute to **nutrient cycling** through ecosystems. The flow of energy and water is like the glue holding it all together. Energy powers nutrients along their path, beginning with photosynthesis. Water serves as the medium in which all nutrients are carried.

Cycles in nature demonstrate important ecological principles. For example:

- ***The Earth is a closed system.***

The air and water now on Earth is all there ever was or ever will be. There are no new sources of air and water.

- ***Energy is neither created nor destroyed, only transformed.***

Cycles are classic examples of this fundamental rule known as the Law of Thermodynamics.

- ***Life dynamics are universal.***

Cycles which make life possible can be found in an Iowa marsh as well as across the African continent. Cycles can be found in the life dynamics of the Pleistocene snail in eastern Iowa as well as in the inner city of Los Angeles, California.

- ***Human activity is indeed a part of, not apart from, nature.***

Numerous materials, including carbon, nitrogen, hydrogen, and oxygen, journey through our bodies during their cycles. Our daily actions constantly influence and are influenced by natural cycles.



## Water talk

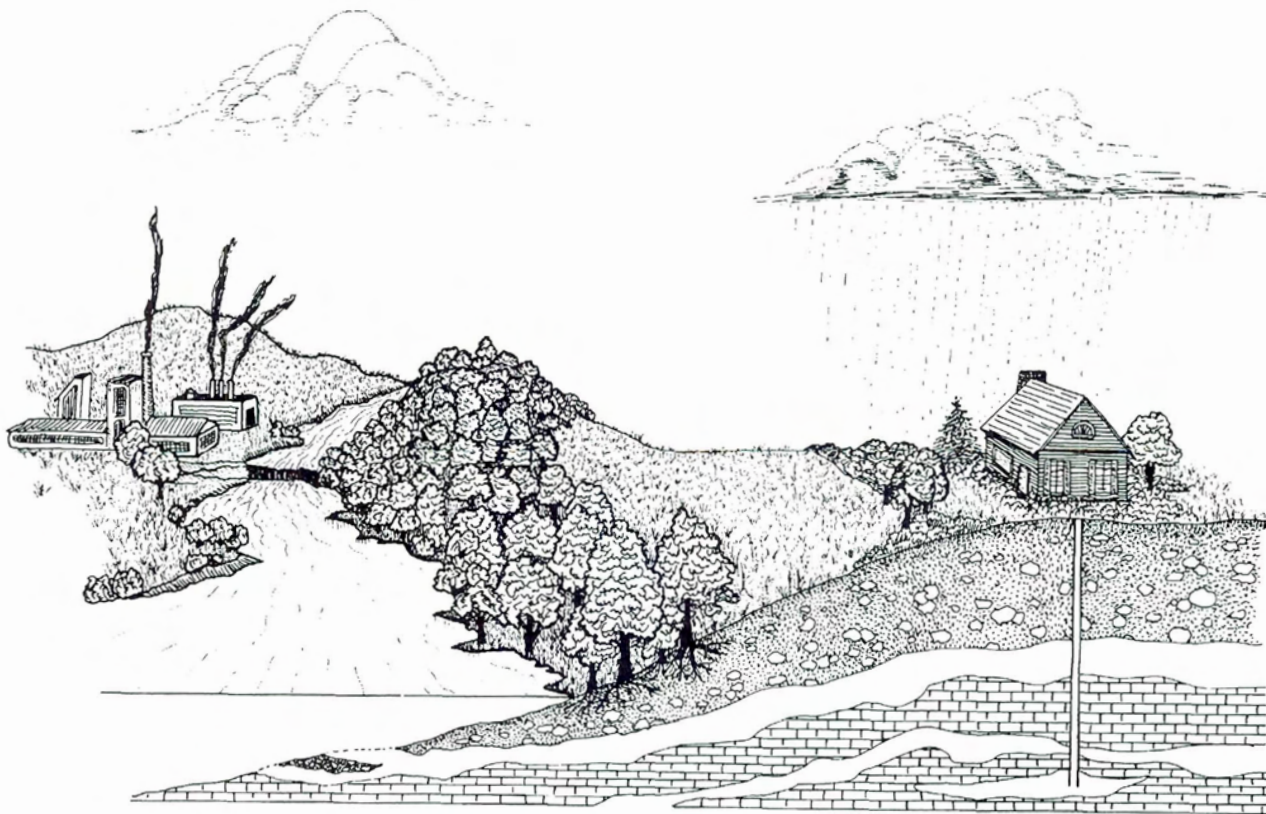
*Where does the rain go when the storm is over?"  
"Into the clouds to make other storms."*

— from *When the Wind Stops* by Charlotte Zolotow

The water cycle involves precipitation, infiltration, transpiration, and evaporation.

### Water cycle

When moisture builds and the clouds gather over Iowa on a hot, humid summer afternoon, we are about to experience the water cycle in action, starting with precipitation.



Moisture first gathers into clouds, collecting on dust and other airborne particles. **Precipitation** falls as either rain, snow, or ice. Tumbling to the earth, the precipitation takes several routes.

Rainfall may first be **intercepted** by plant or building surfaces where it evaporates back into the atmosphere. Once at ground level, precipitation may move quickly over the land toward rivers and lakes as **surface runoff**.

Precipitation that reaches the soil and begins the slower process of **infiltration** will move downward toward underground water supplies. Recharged groundwater finds its way into springs, streams, rivers, and, eventually, oceans. As it courses its way through the soil, some of the water will be taken up by plants or **consumed** through domestic and industrial use.

Finally, either through **transpiration** from plants or surface **evaporation** from lakes and rivers, moisture again moves back into the atmosphere to start the cycle all over again.

### **An issue of water quality**

Water is just as good at soaking clean last night's baking dish as it is at flushing countless nutrients through ecosystems. We call water the **universal solvent** to describe its ability to readily dissolve many different substances. This characteristic of water is why it is so central to any cycle. At the same time, this characteristic is why water quality issues can be very serious. In Iowa, the quality of our drinking water is one of the state's key water issues.



Groundwater supplies drinking water for approximately 80 percent of all Iowans and virtually all private rural users. Inputs to the water cycle through the ground, then, have a significant impact on Iowa's drinking water quality. With more than 85 percent of Iowa's land in agricultural production, water quality concerns in Iowa are closely linked to agricultural practices.

Modern farming practices often involve heavy fertilizer and pesticide application. Earthen lagoons are used for manure storage and some farming practices often result in soil erosion. All of these practices can have serious water quality consequences. Abandoned hazardous waste sites, landfills, leaking underground storage tanks, lawn chemical application, industrial effluent, and sewage treatment also have significant impact on water quality in Iowa.

### **Weather talk, water talk: water quantity**

Even though weather and rain are popular topics of conversation here in Iowa, it is easy to take water for granted. The water rights battles of the western United States seem "out of sight, out of mind" for Iowans who assume general abundance of water. In fact, quality will continue to overshadow quantity as Iowa's predominant water issue. But new and growing water demands from concentrated livestock operations, industrial production, and barge transportation may result in increased focus on water quantity in certain areas of the state.

## Cycles close up

*"And the leaves in the forest when they turn color and fall?"  
"Into the ground to become part of new trees with new leaves."*

— from *When the Wind Stops* by Charlotte Zolotow

**W**e sense nutrient cycles all around us. When we smell fall in the air, our noses are detecting decomposition and the release of carbon for reuse. That rotten-egg odor near a marsh is sulfur released back into the atmosphere. When we watch lightning, we see high-energy forces fixing atmospheric nitrogen into nitrate to be carried to the ground in rainwater.

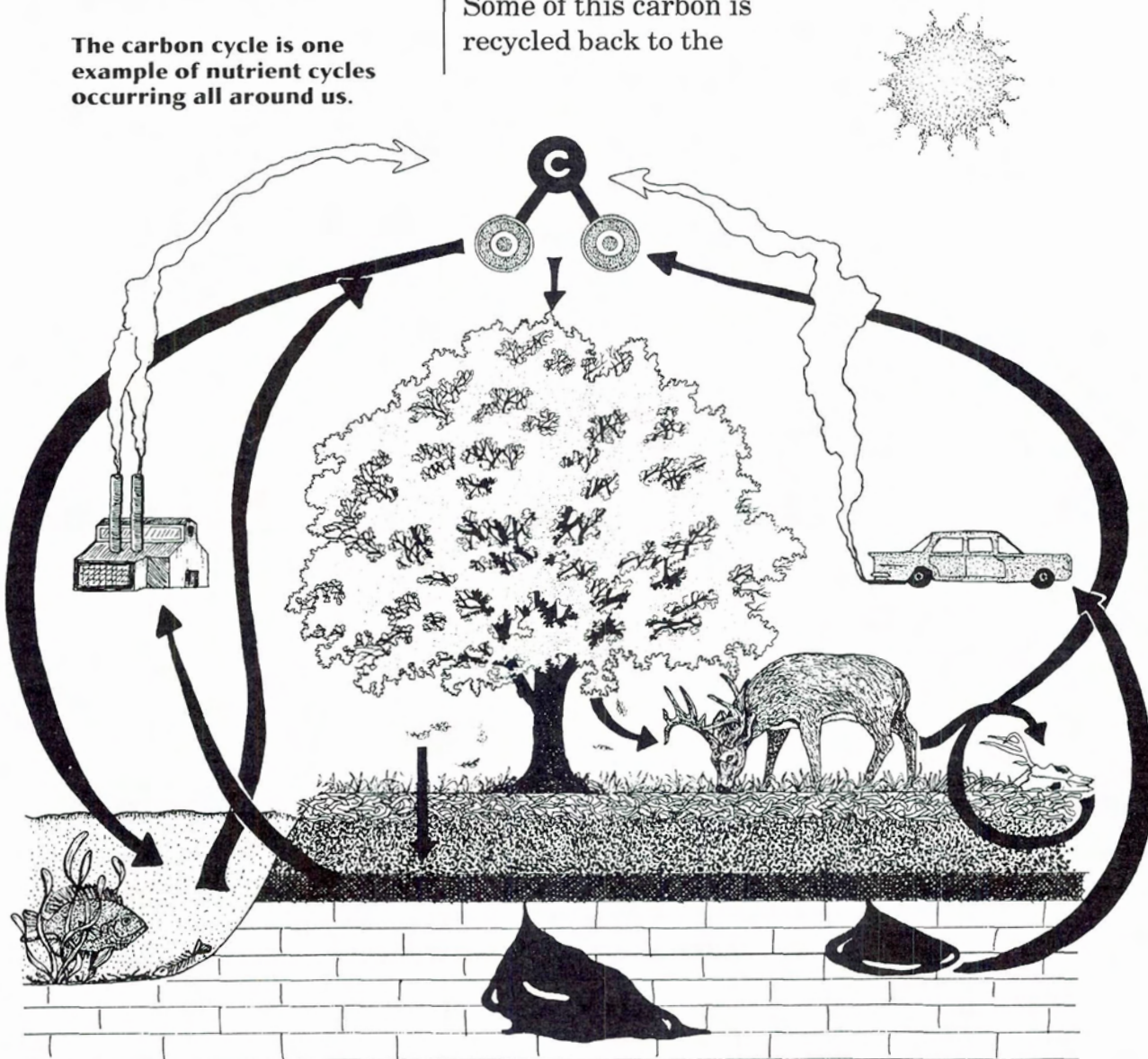
Nutrients needed in large quantities, such as nitrogen, oxygen, carbon, calcium, and phosphorous, are known as **macronutrients**. Nutrients needed in smaller quantities, such as copper, zinc, and iron, are known as **micronutrients**. While needed in smaller amounts, a fine balance of micronutrients is critical to plant and animal well-being.

The cycling of nutrients through ecosystems is made possible by green plants, consumers, decomposers, air, and water. Green plants organize the nutrients into biologically useful compounds, while consumers use the nutrients for body growth and maintenance. Decomposers, such as bacteria and fungi, return nutrients to their simple elemental state. And air and water transport nutrients through living and non-living parts of the ecosystem.



The cycling of carbon, a basic component of all organic material, illustrates the dynamics of nutrient cycling. Like other gaseous cycles, the main source of carbon is found in the atmosphere as carbon dioxide. Carbon dioxide is taken up by plants through photosynthesis. The plants transform the carbon into carbohydrates which move up the food chain as animals consume plants. Meat-eaters pass carbon one more step up the food chain when they feed on herbivores. Some carbon is stored in plant tissue, in bodies of animals, and exoskeletons of invertebrates. Some of this carbon is recycled back to the

The carbon cycle is one example of nutrient cycles occurring all around us.



atmosphere through either decomposition or combustion as in forest and prairie fires. Combustion of fossil fuels is another way carbon is returned to the atmosphere. Some carbon also may become buried deep in the earth. Isolated from biotic activity, this carbon source may be transformed into limestone or fossil fuel deposits of coal, oil, and gas.

The rate of nutrient cycling depends upon characteristics of the nutrient and environmental conditions such as soil moisture, temperature, and precipitation. Because of this, nutrient cycling regionally can be very specific. Consider the consequences of introducing intensive agriculture developed in northern climates to tropical climates. In northern temperate areas, many nutrients are stored in the soil; in tropical areas, many nutrients are stored in the biomass of plants and animals. Removal of the temperate forest leaves a pool of nutrients in place that is available for cycling through agricultural processes. However, removal of the tropical forest depletes the pool of nutrients and takes away the land's ability to hold and recycle nutrients. It is no wonder the productivity of tropical farmland is short-lived.

### Round and round we go: Abuse and use of cycles

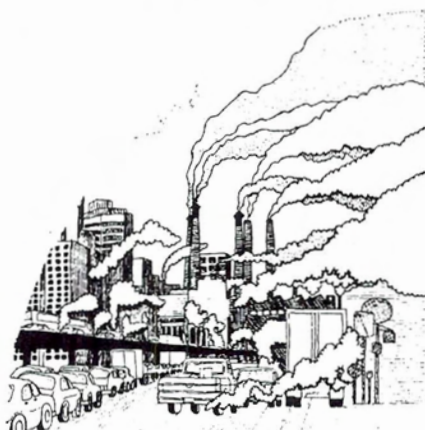
**E**cosystems have evolved around an equilibrium of cycle inputs and outputs that contributes to long-term stability. When the equilibrium of cycles is disturbed, the ecosystem is disturbed. Human activity has done just this. Technological developments have sped up movement of materials until some cycles no longer function as they did in



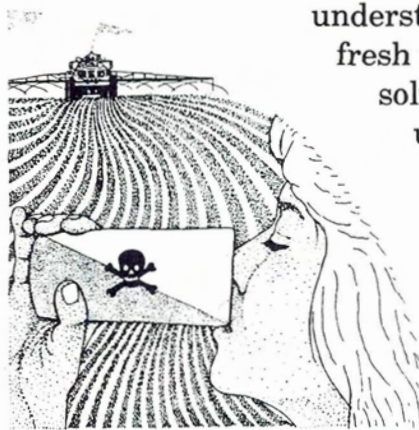
the past. Abused cycles result in the paradox of too little here and too much there. Examples of this paradox are found in soil erosion, water contamination, wildlife habitat loss, and air pollution.

Technical solutions to environmental problems are possible but often expensive and miss some very important lessons from nature.

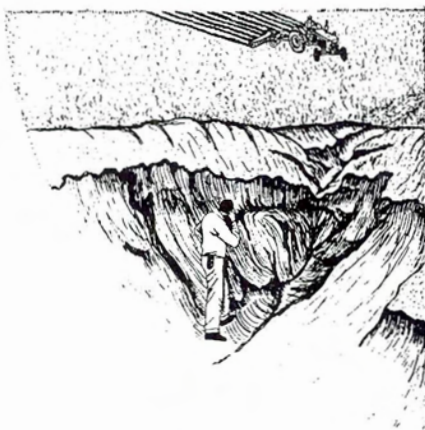
**Congested and polluted cities**



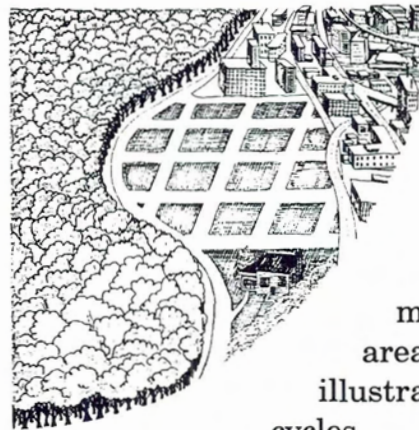
**Water pollution**



Cycles are so basic to the environment that understanding them can offer fresh insight for problem-solving. A first step is to understand environmental problems as cycles out of balance and conservation as strategies that return a dynamic balance to cycles. Ecological problem-solving reveals exciting possibilities for the environment, economy, and society. Agriculture, energy use, and waste management are three areas discussed here to illustrate the abuse and use of cycles.



**Soil erosion**



**Urban sprawl**

**Abused cycles result in the paradox of too little here and too much there.**

## Agriculture

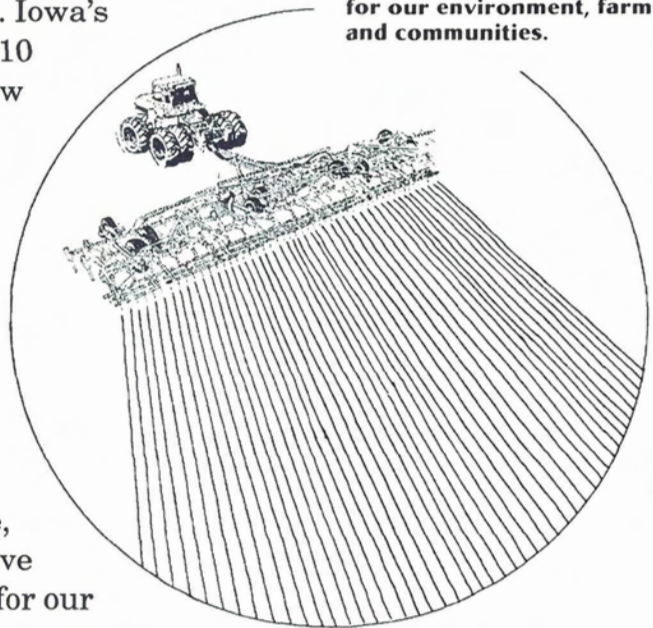
**B**uilt under tallgrass prairies, the state's "black gold" soil is some of the best in the world. Iowa's soil-dependent agriculture contributed \$10 billion to the state's economy in 1992. Few industries get us closer to basic cycles or have a greater economic and social impact in Iowa than agriculture.

The breaking of the prairie sod in the mid-1800s, with the advent of the moldboard plow, began to open Iowa's rich, black resource both to greater use and abuse. Modern cultivation practices involve limited crop diversity, large fields for production, heavy chemical use, and large machinery. These practices have brought us abundant food but at a price for our environment, farmers, and communities.

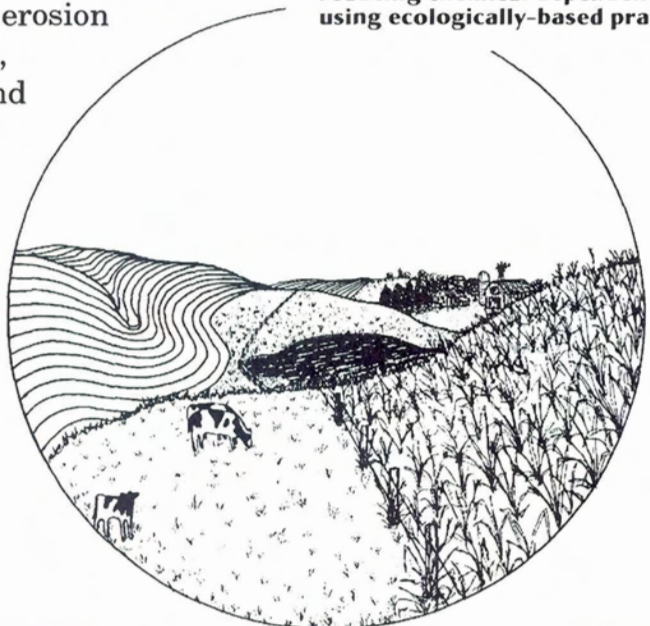
Soil is the number one water pollutant by volume in Iowa. Rowcrop farming, reduced perennial field covers, and fall tillage leave soil vulnerable to erosion by both water and wind. And soil erosion is expensive. It reduces field productivity, impedes field drainage, damages lakes and rivers for wildlife and recreation, and stresses municipal water systems. Soil removal operations to clean rivers, lakes, culverts, tiles, and road ditches are very costly.

Heavy use of chemical fertilizers and pesticides in Iowa agriculture change both the types and quantities of inputs to the water cycle. Both surface water and groundwater are at risk of contamination.

**Conventional monocultural farming has brought us abundant food but at a price for our environment, farmers, and communities.**



**Sustainable agriculture focuses on reducing chemical dependency and using ecologically-based practices.**





On a broader scale, modern agriculture has impacted the health of farmers, has often left wildlife out of the equation, and has contributed to the decline of rural communities. Chemical use and long hours spent around heavy equipment increases health hazards ranging from cancer risk to loss of appendages. Government programs that encourage intensive production leave little room for wildlife. And industrialization of agriculture, leading to larger and fewer farms, has had a detrimental impact on rural farming communities.

There is an alternative. Farming in harmony with the environment with the goal of a whole and healthy agricultural ecosystem is known as **sustainable agriculture**. The focus of sustainable agriculture is on two main strategies: reducing chemical dependency and using ecologically-based practices. Sustainable agriculture is a goal rather than a set technology. A sample of practices include crop rotation, use of manure, buffer strips, and increased reliance on biological and mechanical processes for weed and insect control. Just as nutrient cycling varies with specific environmental characteristics, so too do sustainable practices. Farming in harmony with the environment takes time and highly-skilled management, but its benefits are the economy, environment, and community in balance with one another.

## Energy use

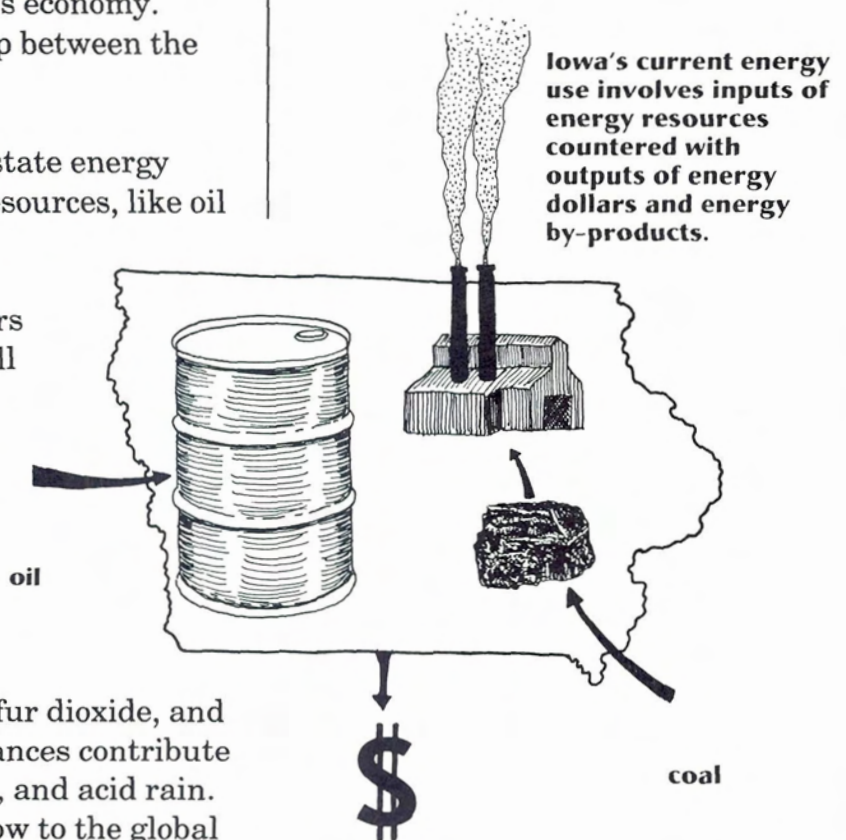
Considered a cycle itself, Iowa's energy use involves inputs of energy resources countered with outputs of energy dollars and energy by-products. An ideal scenario would involve efficient use of locally-available energy resources and circulation

of energy dollars through the state's economy. Currently, there is a significant gap between the ideal and reality.

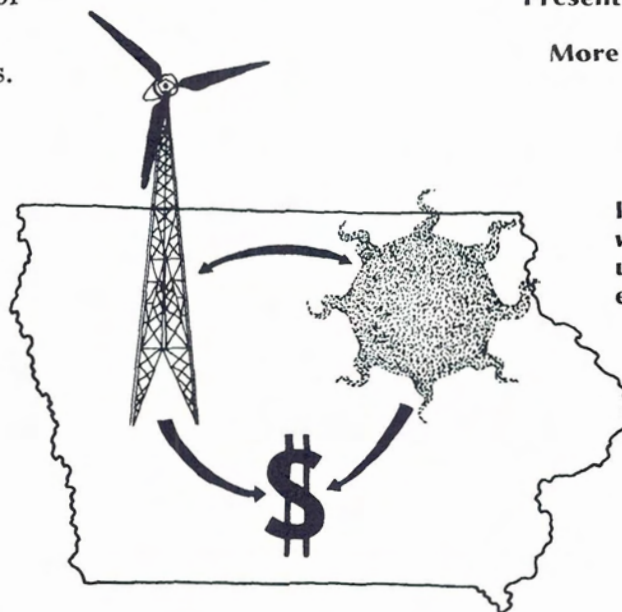
Iowa depends heavily upon out-of-state energy resources. In fact, nonrenewable resources, like oil and gas, made up more than 95 percent of our energy demand in 1994. As a result, \$5.1 billion dollars — 97 percent of our 1994 energy bill — were exported and lost from our local economies.

The chief environmental consequence of Iowa's energy use is our contribution to increased air pollution. Burning fossil fuels overloads the ecosystem with carbon dioxide, sulfur dioxide, and nitrogen oxides. These cycle imbalances contribute to global warming, ozone depletion, and acid rain. Once again, we're provided a window to the global impacts of local activity. The agriculture and manufacturing industries' dependence upon fossil fuels contributes to a variety of other problems ranging from water pollution to habitat loss.

There are alternatives. Learning new systems and using alternative energy sources can improve the sustainability of our energy use. Urban planning, transportation alternatives, and innovative food systems are just three models that can help balance Iowa's energy cycle. Each offers improved energy use with environmental, economic, and social benefits.



**Present energy use  
vs.  
More ideal use**



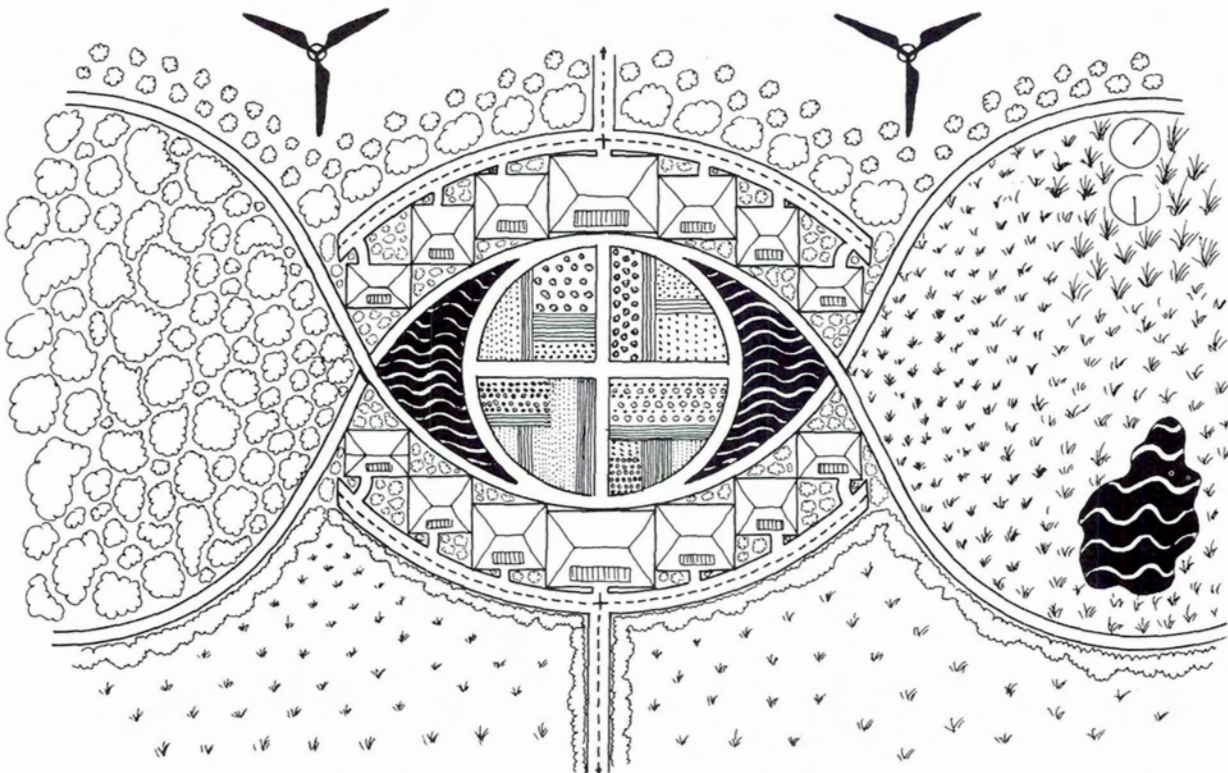


### Model 1: Urban planning with a twist

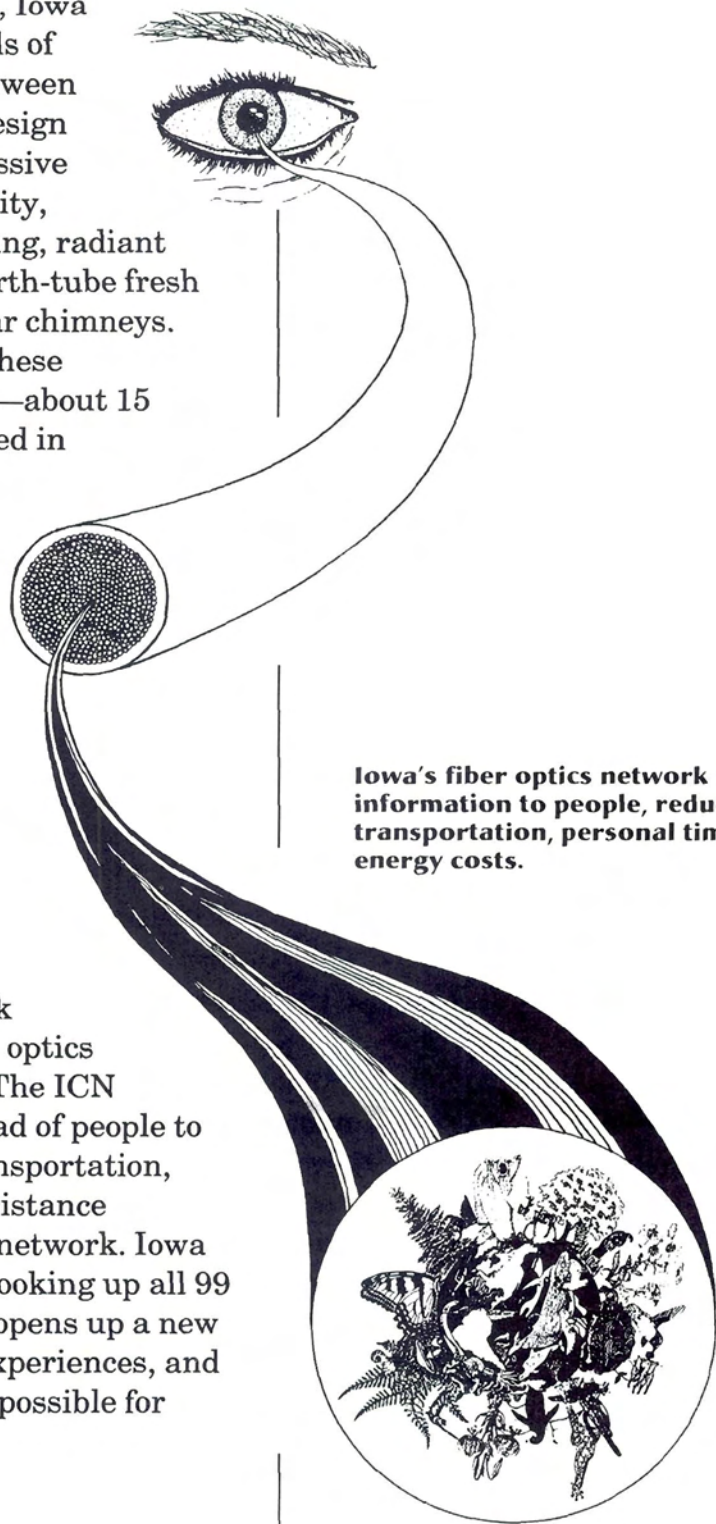
Uncontrolled urban growth consumes more energy, land, and water to meet people's needs. Congested transportation, associated air pollution, reduced green space, and violence are just some of the issues facing the urban ecosystem. An ecological twist to urban planning provides greater sensitivity to integrating the environment and humans.

**An ecological twist to urban planning provides greater sensitivity to integrating the environment and humans.**

Village Homes, for example, is a community designed around holistic principles of aggressive energy conservation. Located in Davis, California, the community's environmental agenda has produced a cascade of community benefits. Solar features in houses, narrow street design, grouping of homes, incorporation of common areas, and use of natural drainage are just some of the innovative designs used. Benefits include fuel conservation, lower air temperatures, neighborhood beautification, lower crime rates, and more space available for vegetable and fruit production.



Homes for Life, Inc. from Fairfield, Iowa designs homes around similar goals of energy efficiency and harmony between residents and the environment. Design features include earthen walls, passive solar designs, photovoltaic electricity, wind generation, solar water heating, radiant heating, water supply systems, earth-tube fresh air systems, greenhouses, and solar chimneys. The increased cost of integrating these technologies into the home design—about 15 percent—is expected to be recovered in fewer than ten years. Long-term savings will continue for the homeowner.

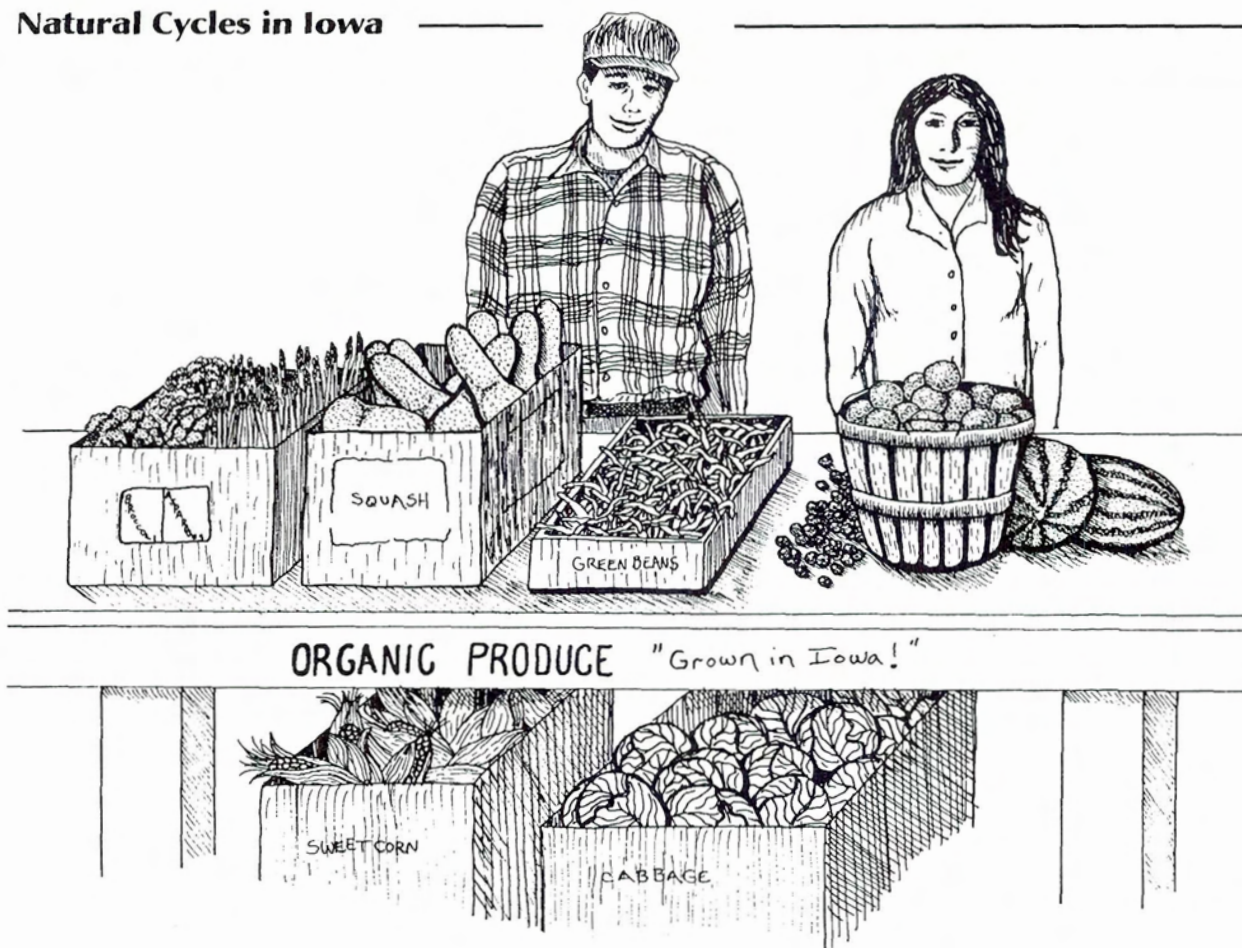


Iowa's fiber optics network moves information to people, reducing transportation, personal time, and energy costs.

### **Model 2: Transportation alternatives**

The Iowa Communication Network (ICN), Iowa's state-of-the-art fiber optics system, began operating in 1994. The ICN moves information to people instead of people to information, thereby reducing transportation, personal time, and energy costs. Distance learning is the primary use of the network. Iowa has taken the lead nationally by hooking up all 99 counties to the network. The ICN opens up a new world of connection with people, experiences, and ideas that otherwise would not be possible for many Iowans .





**Iowa's network of farmer's markets links consumers with farmers and offers numerous benefits to the environment and society.**

### **Model 3: The food we eat**

The many consequences of modern agricultural practices discussed earlier call for fresh approaches to the food we eat. Food production systems that directly link consumers with farmers help to conserve fossil fuel, keep dollars in the local community, and build connections between people and the land. Iowa's network of farmer's markets is a good example. An expanded model is called community supported agriculture (CSA). Simplified, CSA involves paying an up-front membership fee to support the farmer in exchange for weekly deliveries of fresh produce throughout the growing season. Community-based farming decisions, field work, and community activities are all part of the CSA design. CSA's are well-established in northeastern states and in urban areas of Minnesota and Wisconsin. Iowa's first CSA began in Iowa City in 1993.

## Waste management

Nature has modeled a fine-tuned approach to waste management, namely decomposition.

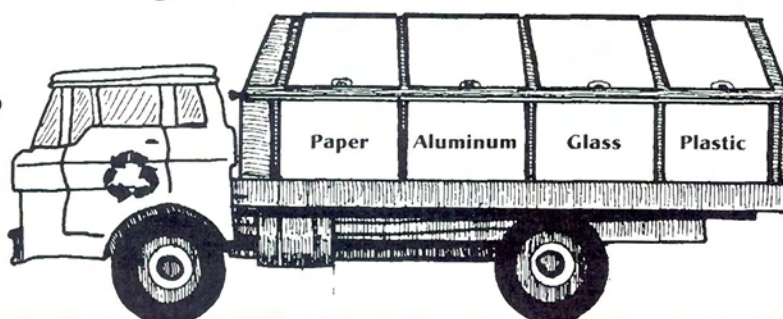
Decomposition plays a critical role in recycling nutrients back through the ecosystem. Humans, however, fail to take nature's waste management to heart. Americans' rate of consumption, compounded by our minimal efforts to recycle, results in cycle imbalance. The imbalance is manifested by the fact that Americans comprise five percent of the world's population yet generate 30 percent of the world's garbage. Spin-off problems resulting from poor waste management include groundwater, river, and air pollution, land use conflicts, and injustice in the location of some hazardous waste sites.

Improvements in the management of our waste come in many forms, from legislation to municipal waste treatment.

### Example 1: Legislative leverage

The 1987 Iowa Groundwater Protection Act mandated that an integrated waste management system—a combination of five waste management strategies—replace the single landfilling option, while the 1989 Waste Volume Reduction and Recycling Act set statewide waste reduction goals. Communities have responded to these laws with approaches ranging from curbside recycling to used tire drives and from household hazardous cleanup days to community composting.

Communities have incorporated curbside recycling, household hazardous cleanup days, and community composting into their waste management strategies.







### **Example 2: Help around the shop**

The Iowa Waste Reduction Center (IWRC), based at the University of Northern Iowa, was created through the 1987

Groundwater Protection Act. IWRC serves as a consortium of

environmental consulting services for small businesses across Iowa.

The center provides on-site review of waste management practices and recommends changes to handle wastes in a safe, cost-effective, and responsible way. A partner service, the By-Product and Waste Search Service, facilitates the transfer of waste materials from one company to another company for reuse or recycling.

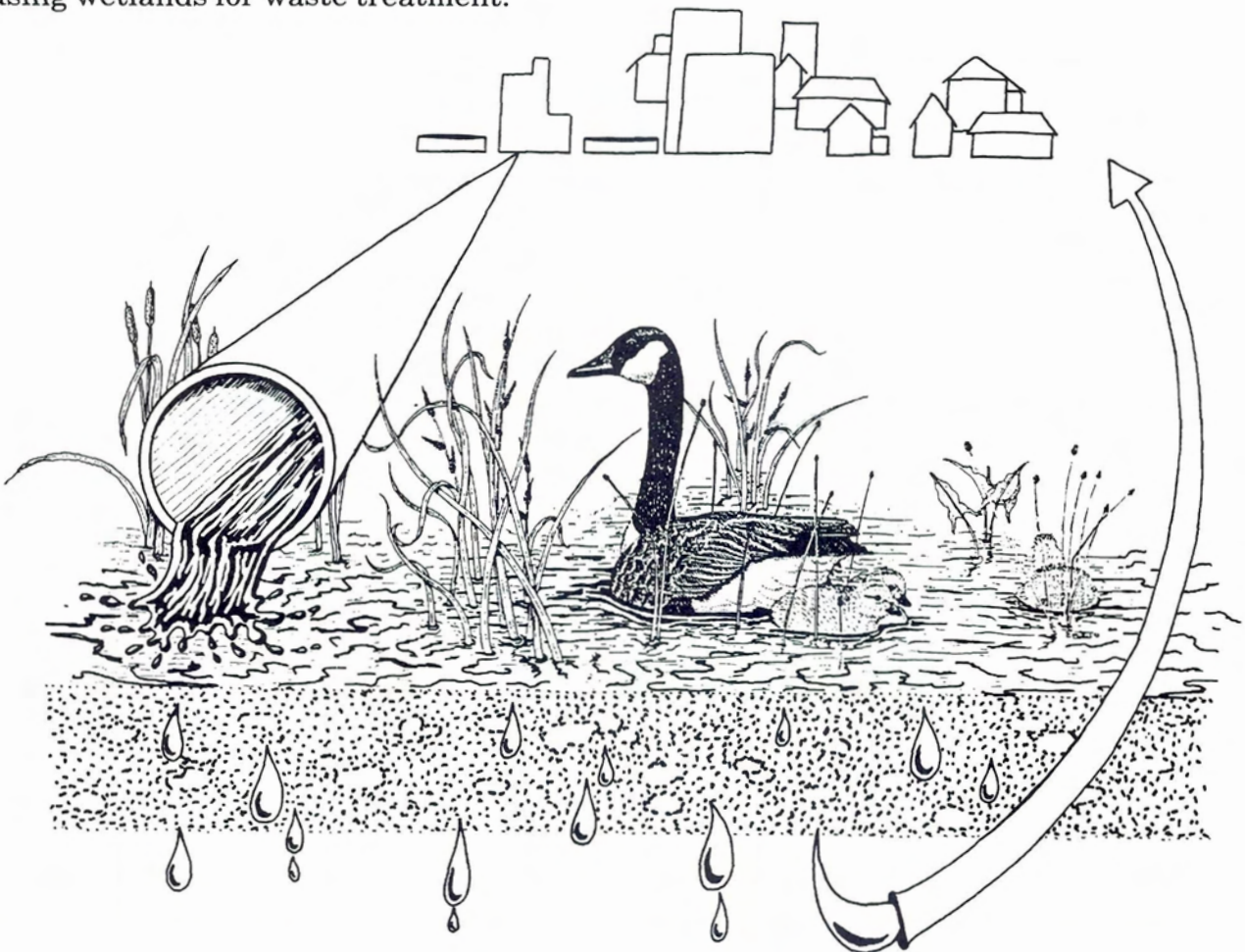


**The Iowa Waste Reduction Center provides environmental consulting services for small businesses across Iowa.**

### Example 3: What's good for the goose is good for Granger

Waterfowl habitat and sewage treatment rolled into one? That's what the community of Granger, Iowa has discovered through its use of wetlands to treat municipal sewage as the tertiary or final stage treatment of sewage. The natural marsh system easily outperforms the best human technology, according to project designers. Two 3.2-acre wetland cells clean the water to meet or better state and federal standards for ammonia, biological oxygen demand, suspended solids, and fecal coliform. One comparison study shows wetland treatment costs four cents per cubic meter compared to traditional treatment which costs 34 cents per cubic meter. Norwalk, LeGrand, and Wapello are other Iowa communities using wetlands for waste treatment.

Some communities have incorporated the use of wetlands to treat municipal sewage.



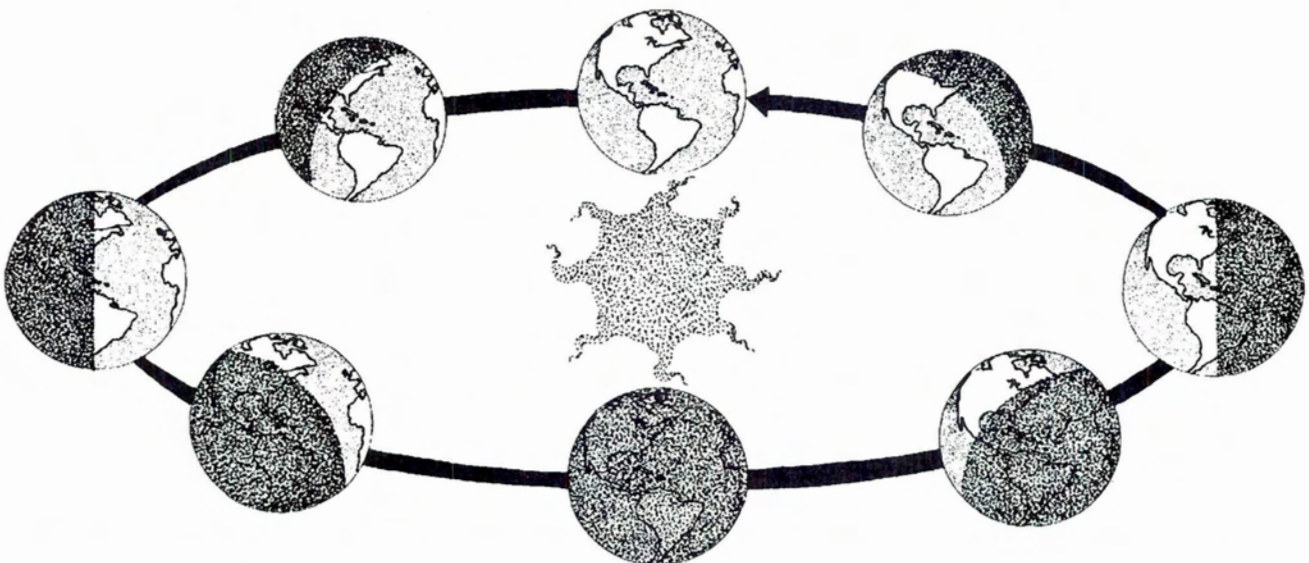


## Coming full circle

**T**he serious environmental problems facing us today can be overwhelming. Growing interest in sustainable living challenges us to learn new ways to live and work with the natural cycles in our lives. Coming full circle to use ecological principles to solve ecological problems offers a renewed sense of hope for the future.

*"It really does go on and on," he said. "Nothing ends..."*  
*"Today is over," his mother said. "It's time for sleep, and tomorrow morning when you awake the moon will be beginning a night far away, and the sun will be here to begin a new day."*  
— from *When the Wind Stops* by Charlotte Zolotow

Fittingly, there is no conclusion for this booklet, just continuation. Look for its ideas and principles circulating within other Iowa Association of Naturalists' booklets and throughout your daily living.



## Useful resources

**Ecology and Field Biology;** Robert Leo Smith; Harper and Row, New York NY; 1980.

**Groundwater Primer for Iowa Issues;** ed.; Iowa Department of Natural Resources, Des Moines, IA; 1989.

**Iowa Waste Reduction Center,** University of Northern Iowa, Cedar Falls, IA. (Call 1-800-422-3109.)

**Urban Forests;** Cheryl Kollin; "Cycling Through the Urban Ecosystem," American Forests, Washington, D.C.; October/November 1994.

**Urban Forests;** Cheryl Kollin; "Issues Related to Nature's Cycles," American Forests, Washington, D.C.; December/January 1995.

**Wetlands for Waste Treatment;** Lowell Washburn; Iowa Conservationist, Des Moines, IA; September 1990.

**When the Wind Stops;** Charlotte Zolotow; Harper Collins, New York NY; 1995. (All quotes from this book are reprinted with permission of Harper Collins Publisher. Reuse of this material without permission from the publisher is prohibited.)



